

Traffic Sensor Network

SD 1210

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Advisor: Bei Gou

Client: Bei Gou

Project Introduction

- Driving a motorized vehicle is one of the most dangerous activities that most of us perform on a daily basis.
- Our project aims to make city roads a safer place by providing useful motor vehicle data, collected at stop signs, to a given client.
- Example: Collected data given to local law enforcement or other traffic monitoring agency

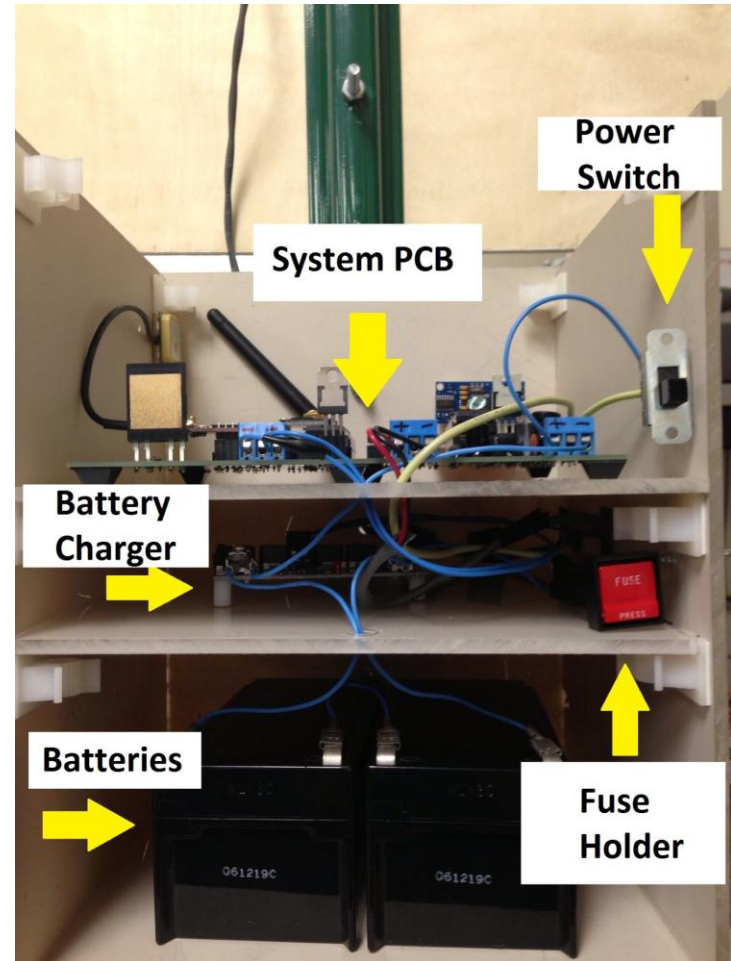
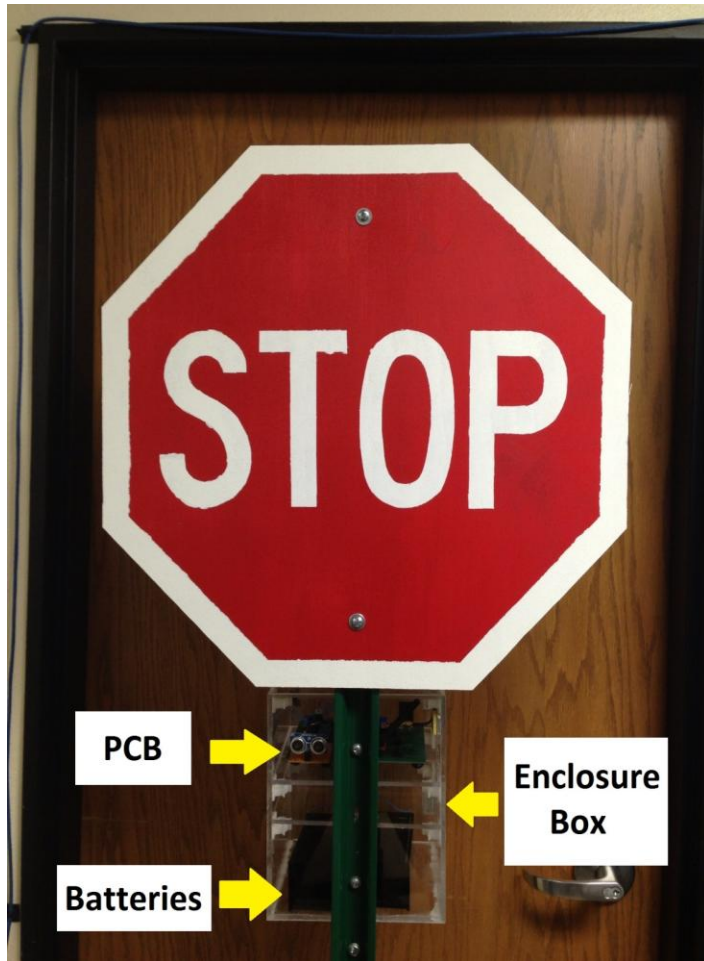
Client/Advisor Requirements

- The stop sign system will record the number of vehicles that have passed
- The system will make a reasonable estimate if a given vehicle stops or not
- The system will detect and record the speed of vehicles as they approach the stop sign
- “Radial” stop sign will send its data to the “central” stop sign
- The “central sign” will not only record its own data, but it will also store the data received from the other stop signs
- The speed of the automobile is saved for use by city officials i.e. the police department
- Integrate a solar panel to charge the battery
- The system should have a simple and economical design

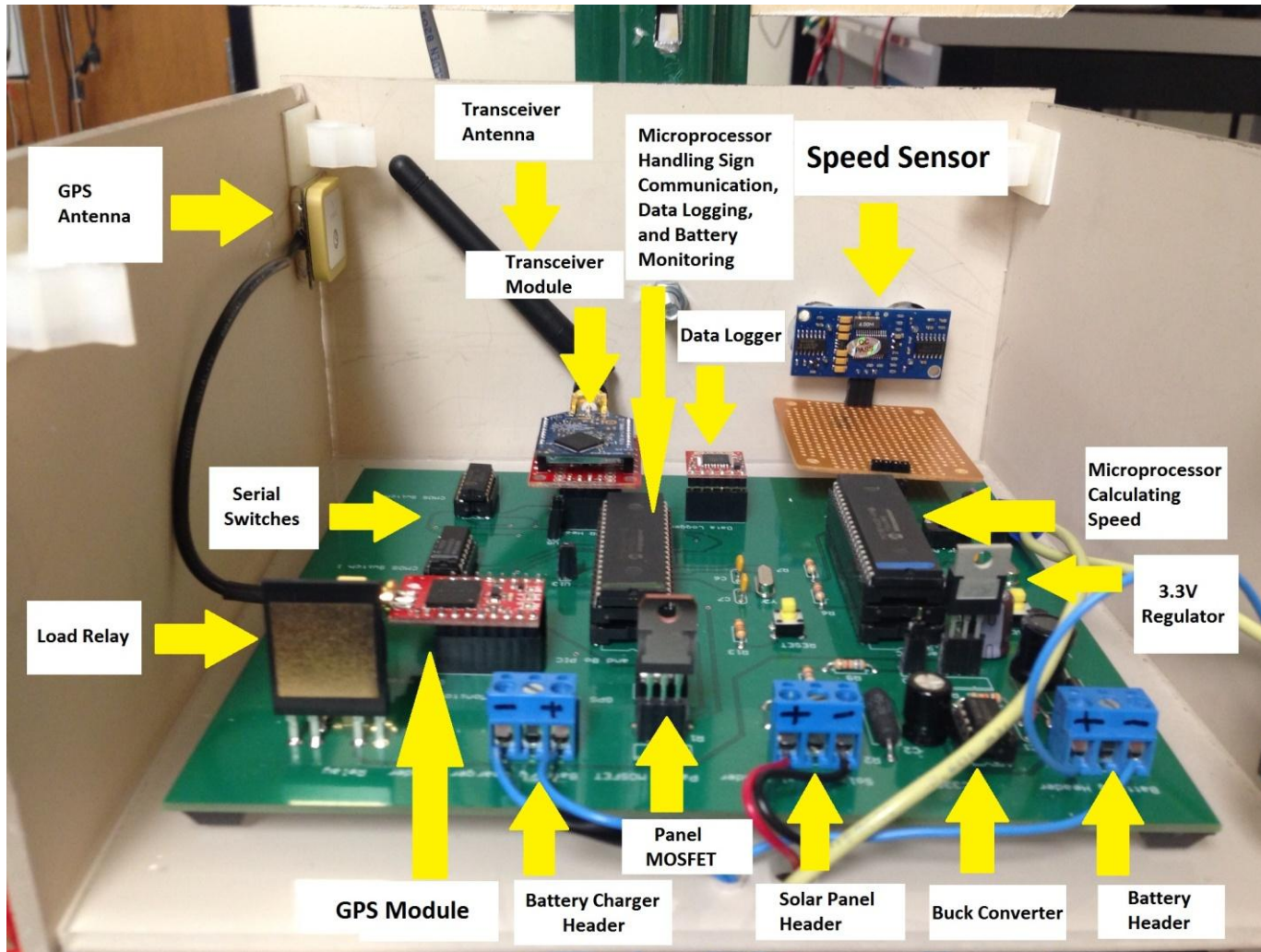
Pictures of System



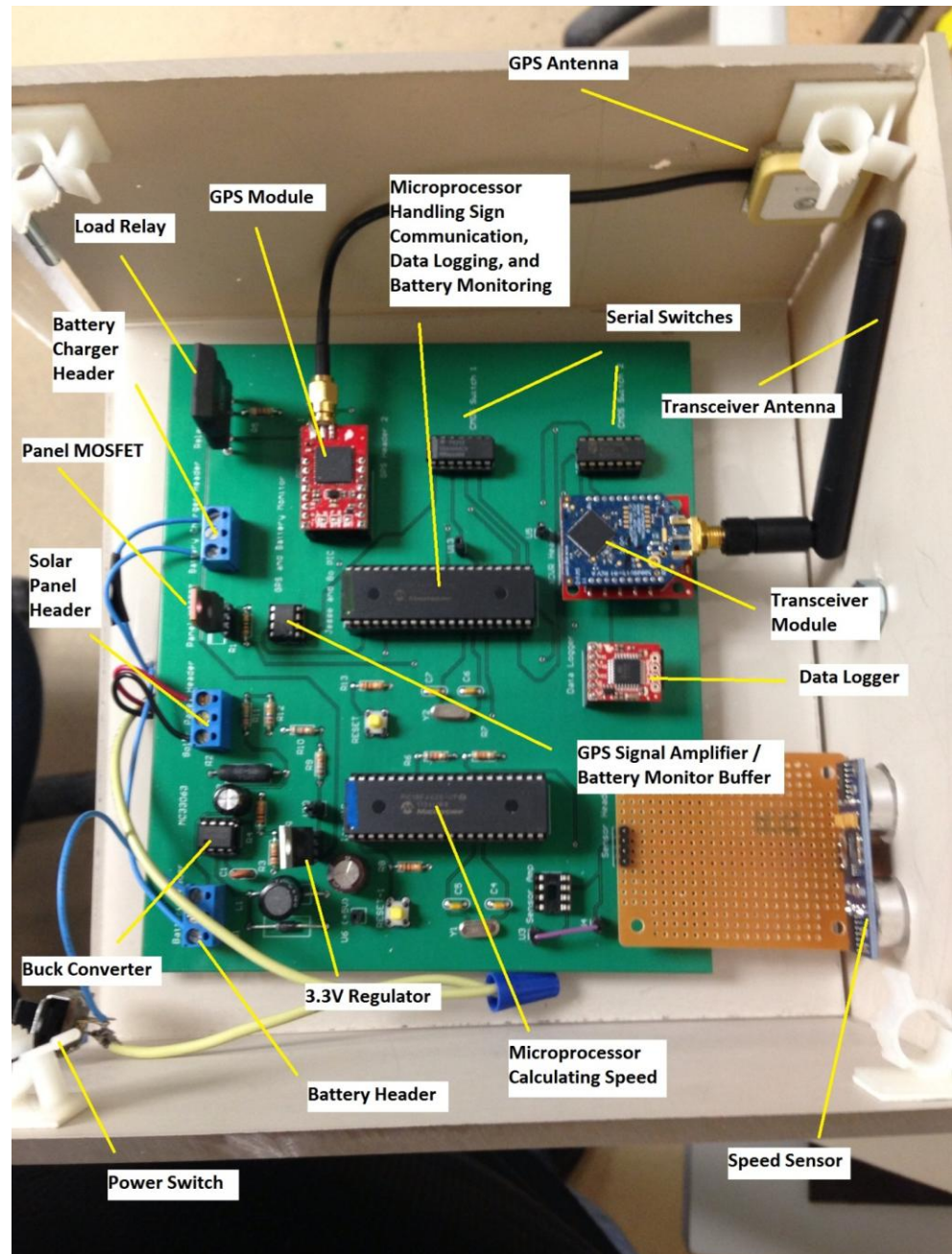
Pictures of Enclosure Box



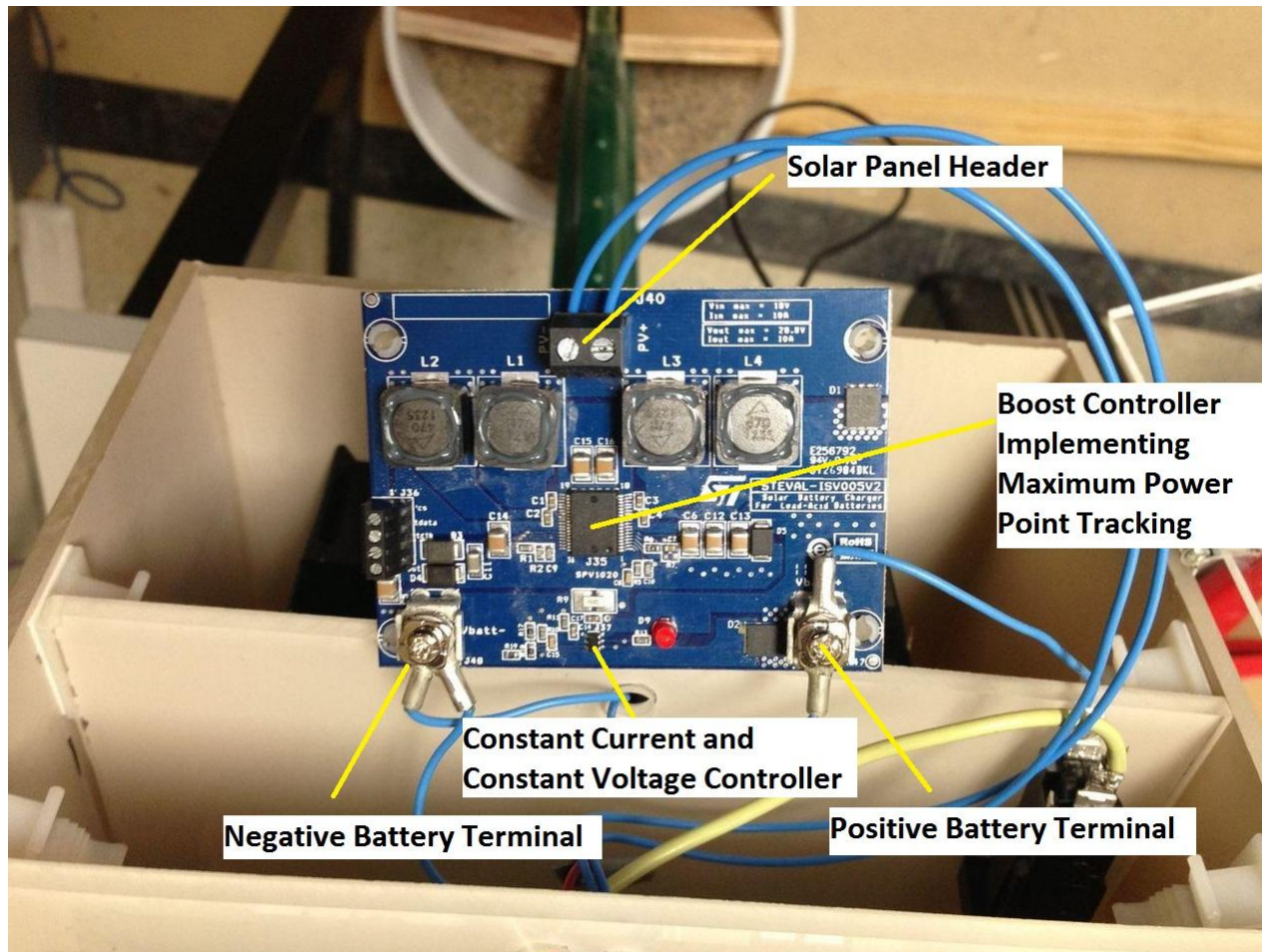
Pictures of PCB



Pictures of PCB

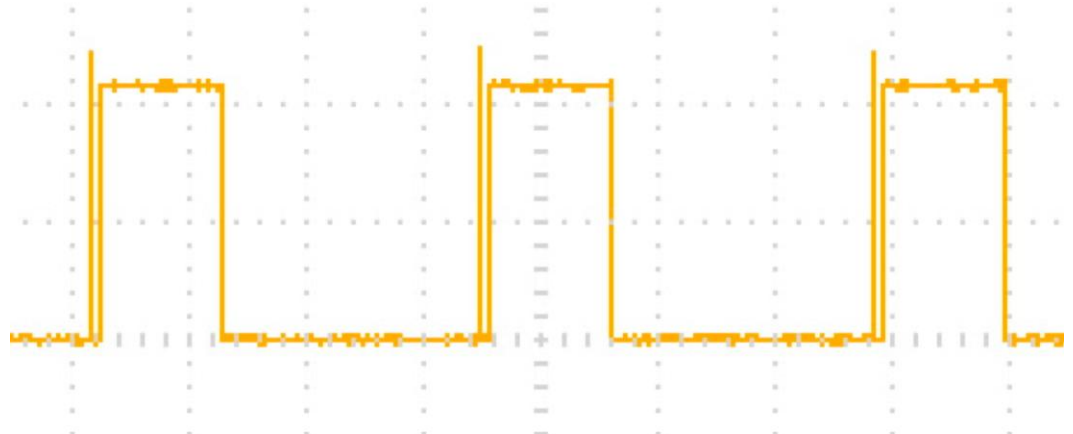


Battery Charger



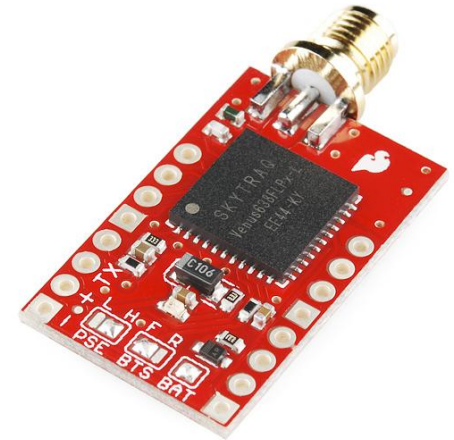
Ultrasonic Sensor

- Detects objects up to a distance of 10ft.
- Detects speed based on multiple distance readings taken over a given time period



GPS

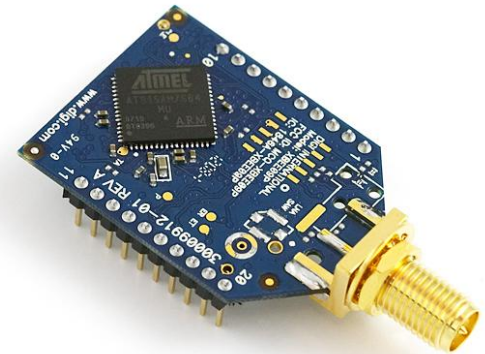
- Venus638FLPx GPS module from Sparkfun Electronics
- Cheap and easy to use
- Used to get accurate date and time



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Transceivers

- Xbee Pro 900 RF module from Sparkfun Electronics
- Inexpensive, long range, and easy to use
- Used to transmit/receive data between stop signs



Data Switching Circuit

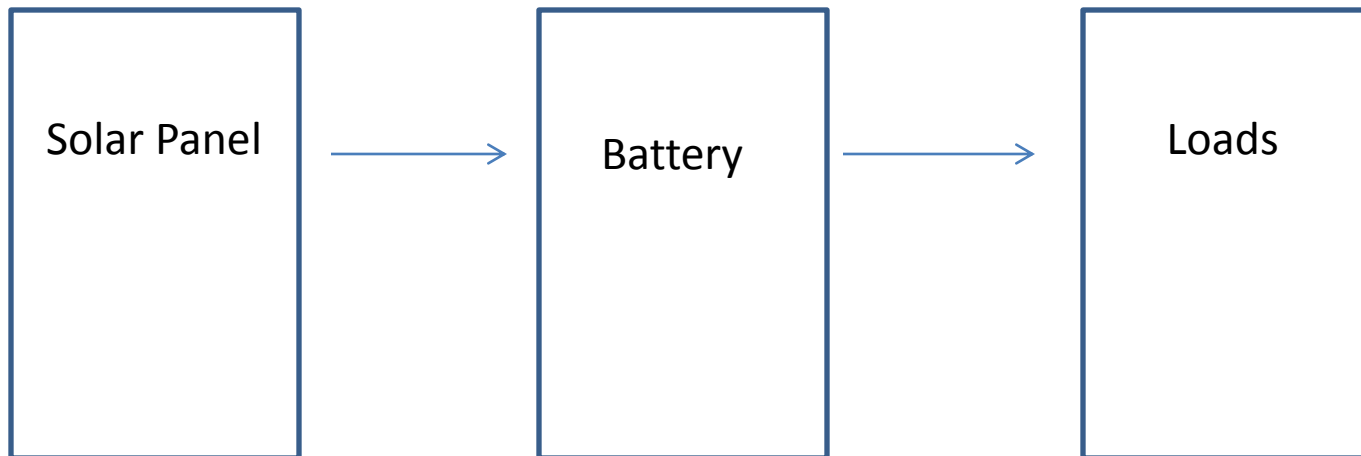
- Microprocessor needs to receive from four devices and transmit to two device, but only has one serial connection
- Use CMOS high speed switches to switch between data connections

How They Work Together

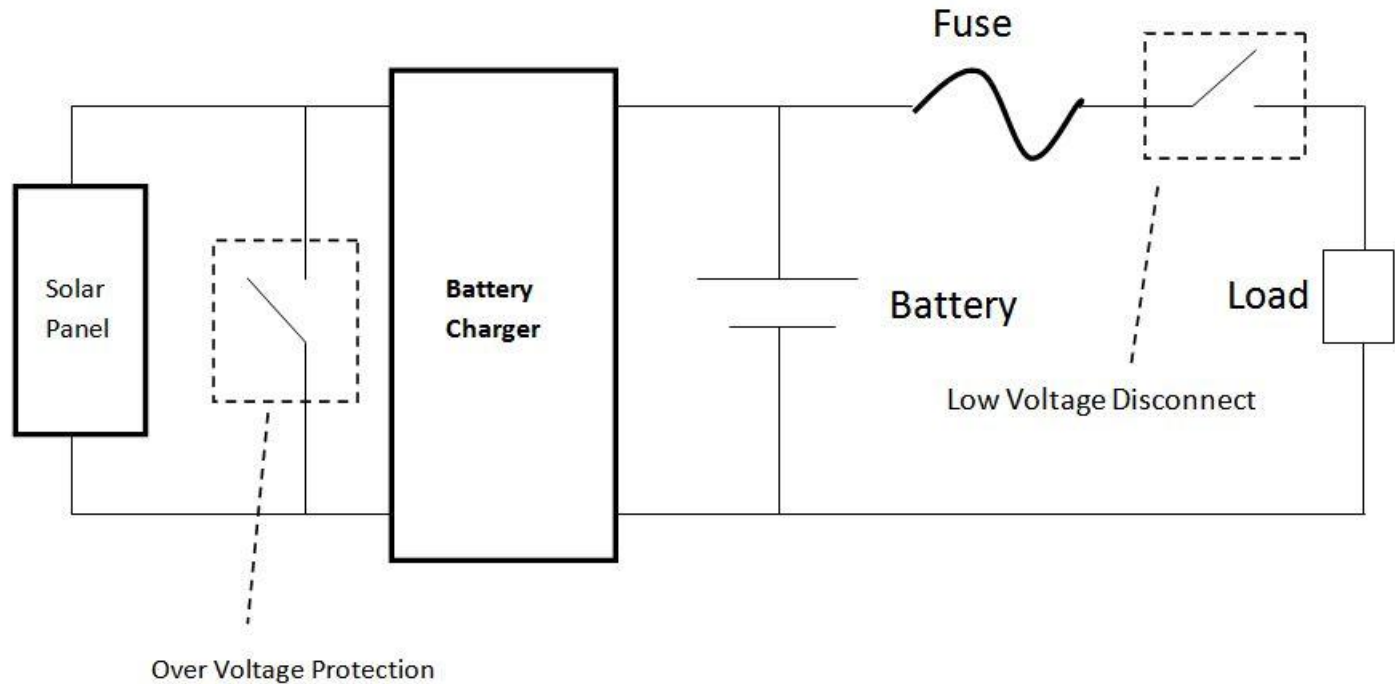


Powering our circuit

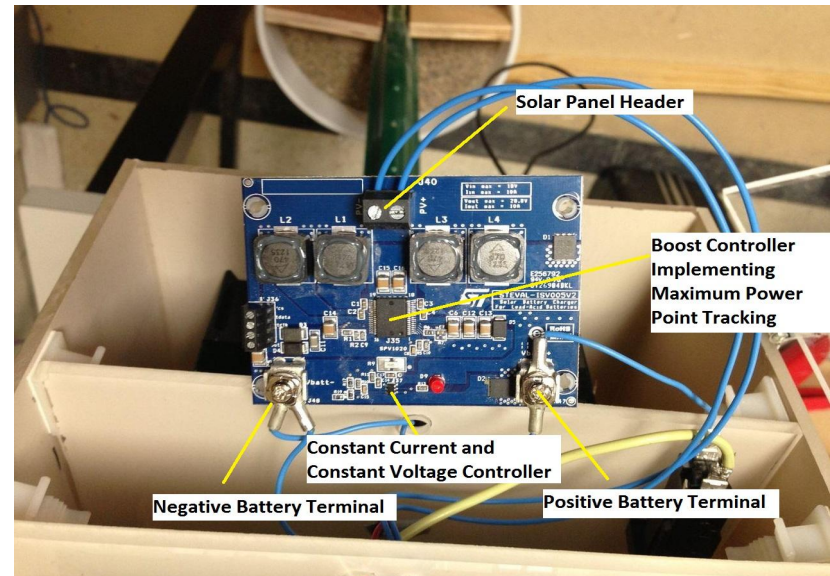
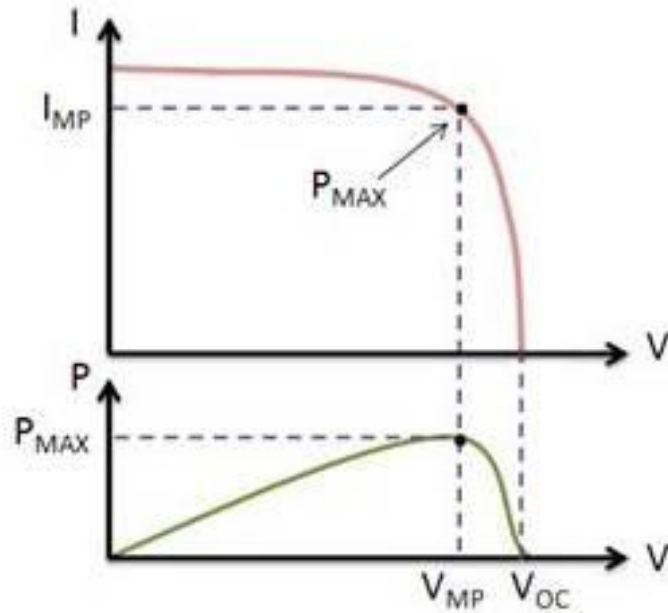
- Solar panel charges battery
- Battery voltage stepped down to power system loads



High Level Power Circuit

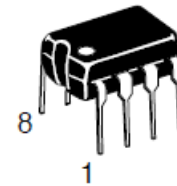
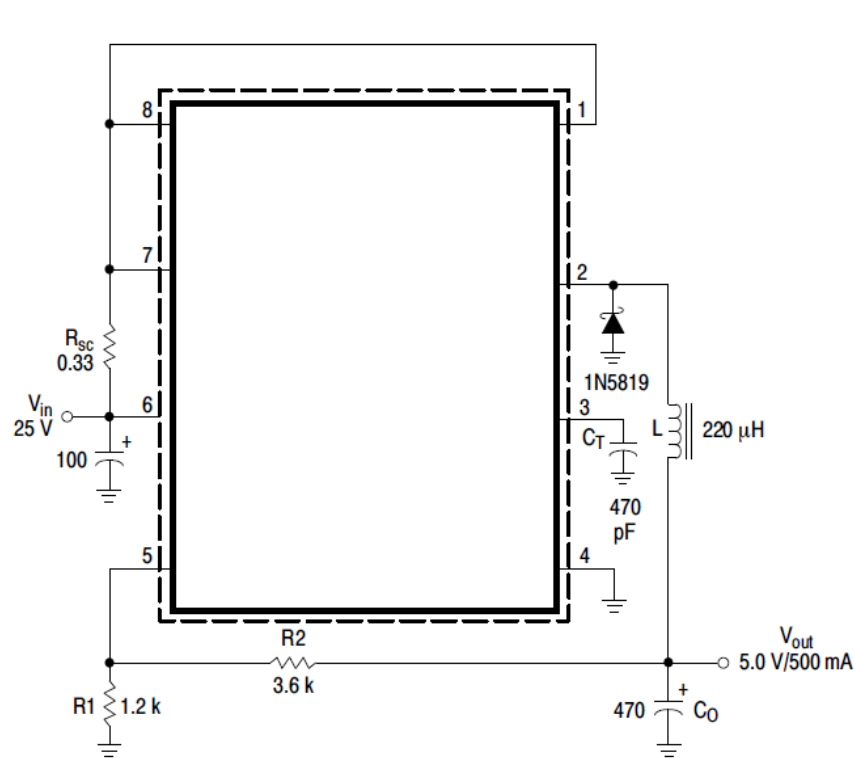


Battery Charger



Buck Converter (MC33063)

$$|V_{out}| = 1.25 \left(1 + \frac{R2}{R1} \right)$$

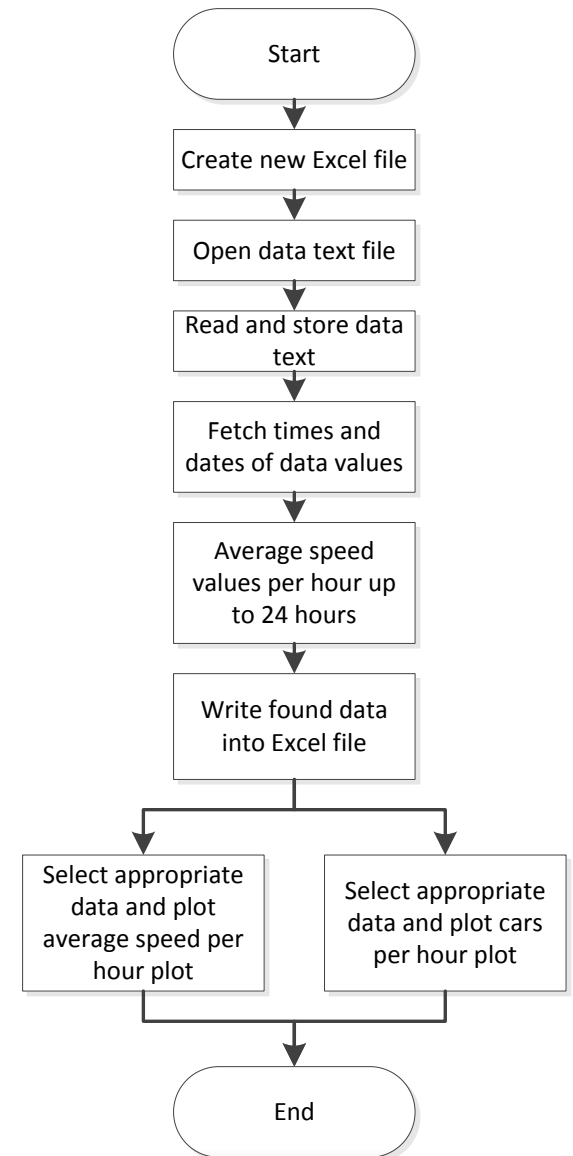


System loads

- Main loads from battery include GPS, transceiver, sensor and microprocessors
- GPS 90mA max current draw then 40-60mA draw once signal is found
- Transceiver 210mA max current draw (transmit current)
- Transceiver 80mA current draw when in receive mode
- Microprocessors 10mA
- Data Logger 3.175 mA
- Sensor 30mA typical current draw

Perl Script

- ActiveState Perl, Excel::Writer::XLSX, and Microsoft Excel 2007+
- Set file path for data .txt file
- Run from command prompt



Problems Encountered / Lessons Learned

- Difficulty finding inexpensive sensor that accurately detects speed
- Outdoor testing was not possible until late in the semester due to cold weather
- Communication between GPS, data logger, the two microprocessors, and transceiver

Testing and Evaluation



Testing Cont.



Data from Data Logger

- [Sign name, Date, Time, Speed]
- SS12704130830150008
- SS12704130832380014
- SS12704130833140021

Videos

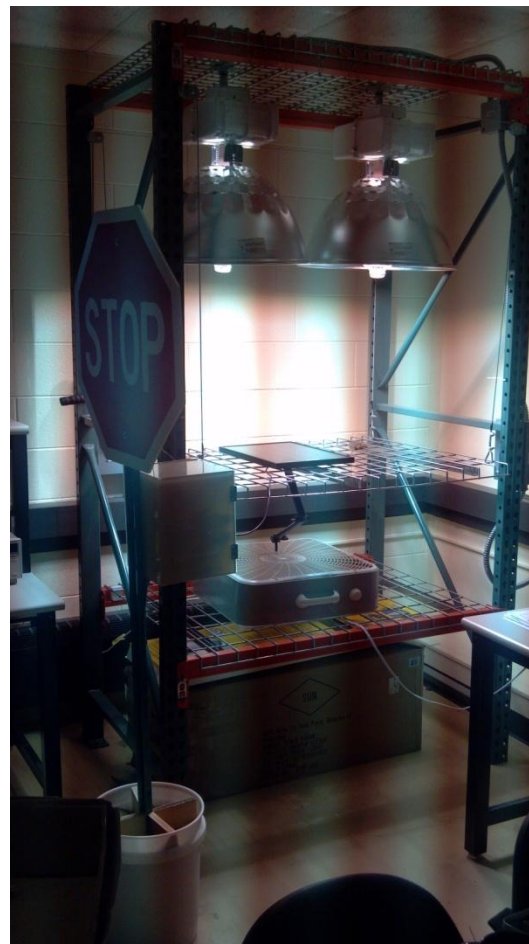
- Car Speed Testing

http://youtu.be/Vb4Ayz_Yk2Y

- Battery Charging

<http://youtu.be/cb471KVzFDk>

Battery Charging



Budget

Total Cost: \$981.16

Part	Quantity	Retail Cost	Acquired Cost	Total Cost
Venus GPS w/ SMA Connector	2	\$49.95	\$49.95	\$99.90
Antenna GPS Embedded SMA	2	\$11.95	\$11.95	\$23.90
OpenLog Datalogger	2	\$24.95	\$24.95	\$49.90
XBee Pro 900 RPSMA	2	\$54.95	\$54.95	\$109.90
900MHz Duck Antenna RP-SMA RoHS Compliant	2	\$7.95	\$7.95	\$15.90
XBee Explorer Regulated	2	\$9.95	\$9.95	\$19.90
IC EEprom 1MBit 20 MHz 8 Dip	2	\$4.40	\$4.40	\$8.80
X-Band Motion Detector, 10.525 GHz, Microwave	3	\$34.99	\$34.99	\$104.97
MOSFET N-CH 60V 11A	4	\$1.33	\$1.33	\$5.32
Solar Battery-Charging Evaluation Board	1	\$75.60	\$75.60	\$75.60
IC MCU FLASH 32KX16 40DIP	2	\$7.94	\$7.94	\$15.88
PCB Order w/ shipping	1	\$51.51	\$51.51	\$51.51
Instapark® All Black 15W Mono-crystalline Solar Panel	1	\$54.90	\$54.90	\$54.90
Final PCBs w/ shipping	2	\$51.51	\$51.51	\$103.02
Solid State Relay	2	\$6.55	\$6.55	\$13.10
.220 30x36 Clear Acrylic Sheet	1	\$54.97	\$54.97	\$54.97
Misc. Shipping	1	\$26.69	\$26.69	\$26.69
Stop-Sign Supplies	1	\$56.09	\$56.09	\$56.09
Misc. Passives/Components	1	\$90.91	\$90.91	\$90.91
12V 7.2Ah Batteries	2	\$19.99	\$0.00	\$39.98

System Cost Per Sign

Part	Cost
Venus GPS w/ SMA Connector	\$49.95
Antenna GPS Embedded SMA	\$11.95
OpenLog Datalogger	\$24.95
XBee Pro 900 RPSMA	\$54.95
900MHz Duck Antenna RP-SMA RoHS Compliant	\$7.95
XBee Explorer Regulated	\$9.95
MOSFET N-CH 60V 11A	\$1.33
Solar Battery-Charging Evaluation Board	\$75.60
PIC Microcontroller 18F4620	\$15.88
PCB Order w/ shipping	\$51.51
Instapark® 15W Mono-Crystalline Solar Panel	\$54.90
Solid State Relay	\$6.55
Enclosure Box	\$54.99
Solar Panel Mounting Bracket	\$19.99
Sensor	\$34.99
Misc. Passives/Components	\$14.99
4GB MicroSD card	\$7.99
12V 7.2Ah Batteries	\$39.98

Total Cost Per Sign: \$538.40

Future Work

- Send data to the “Cloud”
- Connect more components to the relay
- Spend more money on higher quality components
- Use a different microprocessor with more serial or other communication ports

Summary

We built a economical, solar-powered sensor network that is capable of detecting a car's speed and transmitting that data between stop signs. Although we were able to collect accurate data, we are aware that the sensor we currently use may not be the most desirable way to obtain a car's speed.

Thank You For Your Time.



Questions?